Custom New Construction Program Guide

V2 August 2022

Version	Date	Revisions
v1	December 2020	Original version
v2	August 2022	Revised incentives; new requirements for envelope calculations, mixed fuel systems, long term care facilities

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1. Introduction

1.1. Program Objectives

Efficiency Nova Scotia (ENS) offers a Custom New Construction (NC) Program that provides support for the design and construction of energy efficient commercial, industrial, institutional, and multi-unit residential buildings. The program objectives are:

1) Support the use of whole-building energy modeling in the design process, to assess design options and optimize building performance; and
2) Support the implementation of energy-saving measures in new buildings

As a Custom program, financial support offered through NC is customized to each project based on its expected electricity savings. Currently, incentives are available for electrical energy savings only.

1.2. Purpose of the Program Guide

The New Construction Program Guide provides key program information for participants and consultants, including:

- Project eligibility and participation requirements
- Program process
- Available funding
- Modeling requirements

The Guide will be updated as needed based on changes to modeling requirements, code versions, or program funding. The most recent version will be available via the NC program website: https://www.efficiencyns.ca/business-program/commercial-new-construction/

Questions related to this Guide, or about the New Construction program, should be addressed to the NC team at nc@efficiencyns.ca.

2. Eligibility

2.1. Project Eligibility

A project must meet the following eligibility criteria to participate in the ENS NC service:

- Project must be in design phase (pre-construction)
- Total conditioned area must be at least 15,000 Ft^2;
- Project must be located in Nova Scotia and save electrical energy;
- Project must be defined as one of the following:
  - A new building;
  - An addition to an existing building;
  - A major renovation* of a building 15,000 Ft^2 (1,394 m^2) or greater;
- Project must implement at least two energy saving measures
- Project must achieve a reduction in total building energy consumption of at least 25%, and must save at least 100,000 kWh of electricity

*eligible major renovations include space usage conversions, combined envelope + HVAC upgrades, or similar. Some renovations may be better suited to Custom Retrofit; ENS program staff will work with owners and consultants to determine the suitable program for renovations.

ENS may deem projects ineligible for support through the NC program based on inadequate electrical energy savings potential; however, other ENS programs may be available to support small projects.

2.2. Eligible Software

Energy models must be prepared using one of the following:

- eQuest;
- IESVE;
- HAP;
- EnergyPlus*

*eligible EnergyPlus software options include Design Builder, Open Studio, Trane TRACE 3D Plus. Other software running on the EnergyPlus engine might be considered on a case-by-case basis.

Refer to section 6 for detailed model requirements.

2.3. Eligible Energy Modelers

Energy models must be submitted by a consultant who:

- Is on the list of Approved Energy Modelers; or
- Has been approved by ENS for a one-time submission (must be approved prior to submitting an energy model)

Consultants who wish to be added to the Approved Modelers list or obtain single-project approval must submit an Experienced Energy Modeler Application and be approved by ENS NC personnel. Please email nc@efficiencyns.ca for more information.

2.4. New Industrial Facilities: Eligible Process Load Savings

Industrial new construction projects are eligible for additional incentives based on reduced energy consumption of process equipment. Projects must meet the following criteria:

- Facility meets general NC eligibility criteria outlined in section 2
- Industrial process loads account for at least 40% of the proposed building's total energy consumption
- Proposed building process loads must have at least 10% electrical energy savings compared to baseline process loads

Facilities with process load savings must also provide documentation to ENS demonstrating the additional costs of energy efficient process equipment compared to baseline equipment. Modeling requirements for industrial facilities are outlined in section 7.10.

3. Program Process

1. In early design, Customer contacts ENS Business Development representative
2. ENS facilitates kick-off meeting with Customer, ENS program staff, Energy Modeling Consultant
3. Energy Modeling Consultant submits application form for ENS review and approval
4. Modeling Consultant works with Project Design team to assess design options
5. Consultant submits preliminary energy model to ENS
6. ENS prepares project agreement based on approved energy model
7. *Modeling incentive is paid upon receipt of signed agreement*
8. When construction is complete, Consultant submits as-built energy model
9. ENS reviews as-built, conducts site verification, adjusts savings if required
10. *Implementation Incentive is paid to Customer*

3.1. Detailed Program Process

The following steps are required in each Custom New Construction project.

1. Project Introduction
    - Project Developer or Project Representative ("Customer") contacts ENS through established contact (Business Development Team) or through the Energy Solution Advisor team
    - If a modeling consultant has not yet been engaged, ENS can provide a list of pre-approved consultants

2. Kick-off Meeting
    - ENS coordinates project kick-off meeting to review key project details, provide an overview of the program process and requirements, and identify potential energy saving measures for the project

3. Program Application
    - Prior to commencing modeling, Energy modeler submits the Energy Modeling Incentive Application on behalf of the project
    - The application must be signed by both the consultant and Customer (or Customer's representative)
    - Upon approval, the project is registered in the NC program, and modeling can proceed

4. Energy Modeling
    - During the design process, the consultant works with the design team to model and assess design iterations
    - ENS can provide *preliminary* incentive estimates during design development, for budgeting purposes; the actual incentive commitment is based on the final design and detailed model

5. Initial Energy Model Submission
    - Modeler prepares submission package containing all required materials (see section 0)
    - ENS reviews the energy model and works with consultant to address required revisions
    - Revisions must be completed before the modeling incentive can be issued

6. Project Agreement
    - ENS prepares the Custom Project Agreement (CPA), which confirms the value of the implementation incentive
    - The CPA must be reviewed and signed by the Customer (or Representative)
    - Following receipt of the signed CPA, the Energy Modeling Incentive is paid to the project owner
    - At this stage, the Customer/Representative may be required to complete a questionnaire (via telephone) as part of standard NC Program evaluation

7. Post-Construction
    - Energy modeler submits an as-built model reflecting any design changes during construction
    - ENS conducts a facility site visit to verify energy efficiency measures

8. Incentive Payment
    - ENS adjusts energy savings based on the site visit and as-built energy model
    - If the savings are less than 85% of the initial model results, the implementation incentive will be adjusted
    - Following any required adjustments, the implementation incentive is paid to the Customer

4. Incentive Structure

4.1. Energy Modeling Incentive

ENS offers an Energy Modeling Incentive that covers 50% of eligible modeling fees, up to $15,000. To qualify, the proposed project must meet the eligibility criteria outlined in section 2 above.

An Energy Modeling Incentive Application must be submitted and approved by ENS in advance of the energy model submission to qualify for this incentive. The energy modeling incentive will be paid to the developer after the energy model is submitted and approved by ENS, and a Project Development Agreement (PDA) is signed between the developer and ENS.

If a project's total electrical energy savings are between 100,000 and 250,000 kWh, the energy modeling incentive amount will be deducted from the final implementation incentive amount. If a project's total electrical energy savings are over 250,000 kWh, both incentives will be paid at their full value.

4.2. Implementation Incentive

The NC Program provides an Implementation Incentive to help offset the capital costs of efficient technologies. The Implementation Incentive is calculated based on the modeled energy savings between the Baseline case and the Proposed case. The Baseline case is the NECB reference building as defined in NECB Part 8 and the guidelines in section 0 of this document. The Proposed case is the project's final design, which includes the measures that will be installed with support from ENS.

The implementation incentive rate is determined based on the building's total energy savings as shown in Table 1:

Table 1: Tiered Incentive Structure

Tier	Criteria	Incentive Rate
Tier 1	Total performance >25% better than baseline	$0.13 per kWh
Tier 2	Total performance >50% better than baseline	$0.14 per kWh
Tier 3	Total performance >60% better than baseline	$0.15 per kWh
Tier 4	Total performance 100% better than baseline (Net Zero)	$0.18 per kWh

Not-for-profit (NFP) & charitable organizations: additional $0.02/kWh, subject to ENS approval

Total energy savings refers to all energy sources and uses (including non-electric energy and lighting).

The Implementation Incentive rate applies to *electrical energy savings* only (not inclusive of lighting savings, see section 6.7 for more information) up to a maximum Implementation Incentive of $750,000. Energy production from a solar PV system will be added to the electrical energy savings; see section 0 for details.

The Initial Energy Model must be submitted and approved by ENS before energy efficiency measures are installed or the project will not be eligible for the Implementation Incentive. The Implementation Incentive will be paid to the developer when the project is constructed and occupied, and when the As-Built Energy Model has been submitted and approved by ENS. If as-built savings are less than 85% of approved original savings, the implementation incentive amount will be adjusted.

5. Energy Modeling Submission Package(s)

5.1. Initial Energy Model Submission

The modeling consultant must provide the following files in the Initial Energy Model Submission Package:

- Energy model simulation files for the Baseline case and Proposed case.
- Proposed building envelope calculations following NECB requirements, completed in the ENS Thermal Bridging Template or similar;
- Architectural, mechanical, and electrical drawings for the building;
- Specification sheets for relevant equipment;
- Any additional calculations completed outside the energy model;
- Explanation of errors or warnings, and explanation of any workarounds used in the model;
- Additional supporting documentation as required (will be determined on a case-by-case basis).

5.2. As-Built Energy Model Update

If any design changes occurred during construction that may affect the building energy consumption, the energy modeler must complete an update to the energy model (As-Built Energy Model) to reflect the actual as-built design. The As-Built Energy Model submission must include the same documents as the Initial Energy Model listed above that reflect the as-built design.

The Implementation Incentive will not be paid to the developer until the As-Built Energy Model is submitted by the energy modeler and approved by ENS.

If the design has not changed, the modeler must submit a statement from the developer confirming that the as-built condition is as per the plans contained in the original submission.

6. Model Requirements

6.1. General Requirements

1. If a project's building permit application was submitted after Jan. 6, 2020, it must follow the NECB 2017 requirements
2. The number, type, and conditioning of thermal zones must be the same in the baseline and proposed.
3. Building schedules should reflect actual building conditions where possible. NECB default schedules may be used when building-specific information is not available.
4. Ventilation rates (in both baseline and proposed) must be set as the lower of ASHRAE 62.1 rates or Maximum capacity of specified equipment
5. Unmet heating hours must be less than 100 in each thermal zone (in both baseline and proposed); baseline unmet cooling hours must be within 10% of proposed
6. For any building using heat pump equipment, the reference building will use single-zone air-source heat pumps (see section 7.4.1)

6.2. Envelope Thermal Bridging

NECB 2017 requires that overall thermal transmittance (effective U value) calculations include the effects of thermal bridging from all assembly components outlined in section 3.1.1.7.(1). This includes, but is not limited to:

- Balconies
- Corners
- Window-wall transitions
- Parapets
- Girt systems
- Spandrels

Effective U values for projects participating in the New Construction Program must be determined through:

a) The calculation method outlined in the ENS Thermal Bridging Template; or
b) Three-dimensional thermal modeling

Calculations must be submitted in the ENS Thermal Bridging Template or similar. A copy of the template is provided to all approved modelers.

The BC Hydro "Building Envelope Thermal Bridging Guide" (BETBG) and ASHRAE RP-1365 "Thermal Performance of Building Envelope Details for Mid- and High-Rise Buildings" are both permitted resources per NECB A-3.1.1.5.(5)(a). The most recent version of the BETBG is available at https://www.bchydro.com/powersmart/business/programs/new-construction.html under "Resources".

Note: these methods are best suited to steel-frame construction. Wood-framed buildings may follow the wood-frame method outlined in NBC 2015 A-9.36.2.4.(1), provided the ratios of frame to cavity are appropriate for the envelope design.

6.3. Geothermal Project Modeling Requirements

Due to the complexities of geothermal modeling, most whole-building energy modeling software is not equipped to accurately simulate the performance of a geothermal field. Therefore, the following modeling approach must be used on any project submissions that include geothermal systems:

- HVAC design engineer models the geothermal field in an industry-standard geothermal software
- Software generates hourly field loop output temperature
- Temperature profile is added as a setpoint schedule in the building energy model
- Software-specific standard practices are used to simulate loop (dummy boiler or similar)

Project submissions must include detailed field design specifications and simulation reports.

6.4. Specialized Facilities

Modeling requirements for specialized facilities such as industrial plants, arenas/rinks, etc. must be reviewed and discussed with Efficiency NS before modeling starts.

6.5. Domestic Hot Water (DWH) Consumption and Load Reduction

DHW consumption in MURBs must be modeled per the Energy Star Multifamily High-Rise Program (MFHR) Simulation Guidelines (Version 1.0, Revision 03) Section 3.9.2. DHW Consumption in other buildings must be modeled per the ASHRAE Handbook – HVAC Applications, Chapter 51, Table 6. The "average daily" values must be used.

Energy savings can be claimed for hot water load reduction attributed to low flow shower and faucet fixtures, and Energy Star clothes washers and dishwashers. The Energy Star Multifamily High-Rise Program (MFHR) Simulation Guidelines (Version 1.0, Revision 03) Section 3.9.2 must be used. A copy of this document is available from ENS by request. The reduction in hot water load must be calculated and input in the energy model.

6.6. Receptacle load reduction using Energy Star Appliances

Energy savings for installing Energy Star appliances (refrigerators, dishwashers, clothes washers and dryers, and stoves) can be quantified using Section 3.10 of the Energy Star MFHR Simulation Guidelines. The reduction in equipment loads for the appliances must be input in the energy model to account for interactive effects.

6.7. Lighting Savings

Lighting savings will not be incentivized through the ENS NC program, because incentives are included in the sale price when purchased via provincial distributers through the ENS Business Energy Rebates (BER) Instant Rebates program. Lighting load reductions should be included in the energy model to account for interactive effects.

6.8. Solar PV Model Requirements

Electrical energy savings achieved through a solar PV system will be added to a project's total electrical savings. Models of PV energy production must be submitted in one of the following:

1. PV Watts
2. RETScreen
3. Helioscope

The PV model must account for site-specific characteristics that affect solar potential (e.g. shading) and must include efficiencies associated with all components of the PV system as per design specifications.

7. Baseline Requirements

7.1. General Requirements

The baseline (reference) building must adhere to the requirements of NECB Part 8 and/or the guidelines in this document. Exceptions to NECB and the NC guidelines will be considered on a case-by-case basis and must be approved prior to an energy model incentive approval.

The NC program baseline requirements are subject to revision based on changes to building codes and market conditions. Project-specific baselines must be confirmed with ENS prior to commencing the energy model. The final project submission must have an approved baseline before the project agreement (incentive commitment) can be prepared for the customer.

Guidelines for the selection of baseline HVAC systems in Multi-Unit Residential Buildings (MURBs) are provided in section 7.7 below. Section 7.9 provides a detailed description of the NECB baseline systems (systems 1 to 6 in NECB Table 8.4.4.7-B). If any components of the proposed HVAC system are not covered in this document, the energy modeler should request clarification from ENS about the baseline system before any energy modeling work begins.

7.2. NC Program NECB Exceptions

Projects participating in the NC Program must comply with NECB Part 8, except for the following:

1. All H/ERVs in MURBs (both single-zone and central systems) shall be modeled with baseline fan power identical to proposed (see section 7.8.1)
2. Water loop heat pump applications in MURBs shall be modeled with unitary air conditioners in the baseline, with auxiliary baseboard heat to match proposed heating energy source
3. New Long Term Care facilities shall follow the requirements outlined in section 7.5.
4. Heat pump water heaters (for service water applications) shall be modeled with an electric boiler baseline.
5. Where a proposed MURB design includes VRF, and the MURB is located in an area where natural gas is available, the baseline shall be modified as per section 0. Otherwise, the baseline shall follow applicable NECB requirements.
6. The baseline requirements for eligible major renovation projects will be assessed on a case-by-case basis

7.3. Baseline Envelope Requirements

7.3.1. Baseline U values

The baseline building shall be modeled with U values equal to the prescriptive requirements outlined in NECB 2017 3.2.

7.3.2. Baseline FDWR

Per the guidelines in the NECB 2017 User Guide, the baseline building shall be modeled with the FDWR set to the maximum allowable in NECB 2017 3.2.1.4, regardless of proposed building FDWR. The maximum FDWR is 0.4 for HDD less than or equal to 4000; see Table A-3.2.1.4.1 for FDWR at various HDD values, and Table C-1 for HDD of various locations in Nova Scotia.

7.4. Baseline HVAC System Requirements: All Buildings except LTC

7.4.1. Proposed HVAC System includes Heat Pump equipment:

Per NECB Part 8, for any thermal zone in the proposed building that is heated by an air-, ground-, or water-source heat pump (excluding water loop heat pumps served by a boiler and cooling tower), the baseline building must include heat pumps that meet the requirements outlined in 8.4.4.13. The baseline for buildings with water-loop heat pump systems is determined from table 8.4.4.7 or from section 6.4 below.

For buildings with heat pump equipment outlined above, the ventilation system type (equipment type, configuration, and quantity) shall be identical to the proposed.

The baseline fan power for mini-split heat pump systems is determined as follows:

1. Ductless mini-splits: NECB 8.4.4.18.5 (fan power is identical to proposed);
2. Ducted mini-splits: NECB 8.4.4.18.3 (supply fan with 640 Pa static pressure and 40% combined efficiency)

7.4.2. Proposed HVAC System does not include Heat Pump equipment:

When the proposed building does not use heat pump equipment, the reference HVAC system is determined from Table 8.4.4.7. Baseline Energy Recovery must be included if required by NECB 5.2.10.

7.4.3. Baseline Energy Recovery Ventilation

All continuously-operating ventilation systems (except those serving a single dwelling unit) must be equipped with energy recovery at 50% effectiveness. For non-continuous ventilation systems, baseline energy recovery must be included if required by NECB 5.2.10.

7.5. Baseline HVAC System: Long-term Care Facilities

- Baseline HVAC system type shall be identical to proposed
  - Equal number of HVAC units in baseline and proposed
  - For proposed systems with hydronic heating/cooling, baseline shall also use hydronic heating/cooling
  - Baseline pump capacity shall meet NECB requirements
- For proposed systems with air- or ground-source heat pumps, the baseline system shall be air-source heat pumps following the requirements of NECB 8.4.4.13, except:
  - Heat pumps shall be multizone/central, per proposed design
- Baseline heat pump COP shall be based on NECB Table 5.2.12.1:
  - Heating COP = 3.0
  - Cooling COP = 2.78
- Baseline fuel-fired equipment shall comply with NECB requirements
- Baseline fan power shall be per NECB 8.4.4.18.-4 for multi-zone systems:
  - Supply: 1000 Pa static pressure, combined efficiency 55%
  - Return: 250 Pa static pressure, combined efficiency 30%
- For systems using MERV filters, the ASHRAE 90.1 filter allowance of 0.9 inches shall be added to NECB values, to account for higher duct pressures associated with filtration:
  - Supply: 1225 Pa static pressure, combined efficiency 55%
  - Return: 475 Pa static pressure, combined efficiency 30%
- Baseline ventilation rates shall be determined as follows:
  - If a 100% fresh air system is a client (operator) requirement, the baseline shall be a 100% fresh air system with ventilation rates equal to proposed
  - If the client does not specifically require 100% fresh air, the baseline will be set as the CSA minimum ventilation rates
- Baseline ventilation system includes heat recovery, with 50% sensible effectiveness
- Where a proposed system design includes terminal reheat, the baseline shall also include terminal reheat

7.6. Baseline for Mixed-Fuel HVAC Systems

When the proposed building's heating system uses more than one fuel type, the reference heating system capacity ratio must match the proposed system's capacity ratio. For the purposes of quantifying electricity savings, the baseline electric and fuel consumption shall be determined based on:

a) The proposed system type(s); and
b) The portion of the proposed annual heating load attributed to each system type.

Capacity ratios must be calculated using the applicable ENS template. Project-specific adjustments or workarounds may be required in some cases; mixed fuel projects should be discussed with the NC team prior to modeling.

7.6.1. Hybrid Geothermal Systems

"Hybrid" geothermal projects are those in which the ground loop is sized to carry a portion of the peak heating load. The baseline system for hybrid designs is as follows:

Proposed Primary Heating	Proposed Auxiliary	Baseline
Centralized geothermal heat pumps (water-to-water heat pump plant)	Fuel or electric boiler	Air-source heat pump with auxiliary heating type same as proposed
Decentralized geothermal heat pumps (extended range WLHPs)	Fuel or electric boiler	Air-source heat pump with auxiliary heating determined based on proposed model results

The capacity ratio of the baseline fuel/electric baseboards will be determined from the proposed model results, following the ENS procedure for hybrid geothermal projects. Modelers must contact NC program staff to review requirements for hybrid geothermal models before starting model development.

7.7. Baseline HVAC System Selection for Multi-Unit Residential Buildings

The following sections outline the baseline HVAC systems for various types of proposed systems:

- Single Zone Air-Source Heat Pumps
- Geothermal and Air-to-Water Systems
- Distributed Water Loop Pumps with boiler/cooling tower (Water Loop heat pumps)
- Hybrid Hydronic Heat Pumps
- Air Cooled Variable Refrigerant Flow Systems

Ventilation system details are provided in section 7.8, for Single-zone HRVs and Central Ventilation Systems.

7.7.1. Single Zone Air-Source Heat Pumps

All ductless heat pumps must be modeled as intermittent operation in both the baseline and proposed. Ducted units must be modeled per design configuration.

System Description	Proposed System Details	Baseline System Details
System Type	Mini-Split Heat Pump	Table 8.4.4.13-Packaged unitary rooftop heat pump
Central Plant	Not Applicable	Not Applicable
Fan Control	Constant-Volume	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18.3) for ducted systems or - 8.4.4.18.5) for ductless systems
Cooling Type	Air cooled direct expansion	Air cooled direct expansion
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode
Heating Type	Air source heat pump	Heat pump
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode
Auxiliary Heating Type	Electric resistance furnace	Electric Resistance
Heat Rejection	Not Applicable	Not Applicable
Heat Rejection Efficiency	Not Applicable	Not Applicable
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

7.7.2. Geothermal and Air-to-Water Systems

The table below applies to the following systems:

- Central Air to Water Heat Pump with back-up boiler;
- Geothermal Heat Pump Plant;
- Geothermal Water Loop Heat Pumps

The baseline system type is single-zone packaged unitary rooftop heat pumps (air source). If the proposed design includes fuel-fired hydronic heating, the system is considered "Hybrid Geothermal" (section 7.6.1).

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	4-pipe Fan coil units for heating and cooling or 2-pipe Fan Coil Units for cooling and baseboards for heating OR Water to air distributed heat pumps (extended range)	Table 8.4.4.13-Packaged unitary rooftop heat pump with electric baseboards	Table 8.4.4.13-Packaged unitary rooftop heat pump with hydronic baseboards
Central Plant	Central Ground Source Heat Pump with back-up boilers OR Central air to water heat pump with back-up boilers OR Ground source loop with back-up boiler	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	

Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Central water to water heat pump	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Central water to water heat pump with back-up boiler	Heat pump and electric resistance	Heat pump and fuel-fired hydronic
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode	
Auxiliary Heating Type	Not Applicable	Electric resistance	The proposed building's ratio of fuel heating energy to electric heating energy shall be applied to the baseline heating energy, to determine the baseline heating electricity use
Heat Rejection	Not Applicable	Not applicable	
Heat Rejection Efficiency	Not Applicable	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

7.7.3. Distributed Water Loop Pumps with boiler/cooling tower

The baseline for buildings with water loop heat pumps (water to air or water to water heat pumps) will be unitary air conditioners and baseboard heating. If the proposed building includes fuel-fired heating in the water loop, the baseline will include fuel-fired hydronic heating with identical setpoints and operating schedule as proposed.

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	Distributed Water to Air Heat Pumps	Unitary air conditioner with electric baseboards	Unitary air conditioner with hydronic baseboards
Central Plant	Boilers Cooling Tower	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Distributed Water to Air Heat Pumps	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Distributed Water to Air Heat Pumps	Electric resistance	Fuel-fired hydronic
Heating Efficiency	Cutsheet	Not applicable	Gas-fired boilers
Auxiliary Heating Type	Not Applicable	Electric resistance	Fuel-fired hydronic; capacity based on proposed design
Heat Rejection	Cooling Towers	Not applicable	
Heat Rejection Efficiency	Cutsheet	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

7.7.4. Hybrid Hydronic Heat Pumps

A hybrid hydronic heat pump is a system of distributed fan coil units with DX cooling and gas-fired hydronic heating, where the DX cooling rejects heat into the hydronic loop. The baseline for hybrid hydronic heat pumps will be an identical system with efficiencies as outlined below.

System Description	Proposed System Details	Baseline System Type
System Type	Hybrid hydronic heat pumps	As per Table 8.4.4.7-A, the baseline system shall be identical to that of the proposed building
Central Plant Type	Condensing boilers Cooling Towers	Identical to proposed
Fan Control	As per design	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Water cooled Direct Expansion	Identical to that of the proposed building
Cooling Efficiency	Cutsheet	Table 5.2.12-Internal Water-loop heat pumps
Heating Type	Condensing fuel fired Boilers	Identical to that of the proposed building
Heating Efficiency	Cutsheet	Gas fired boilers
Auxiliary Heating Type	Not Applicable	Not Applicable
Heat Rejection	Cooling Towers	Cooling Towers
Heat Rejection Efficiency	Cutsheet	Table 5.2.12-Cooling towers-propeller or axial fan, direct
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

7.7.5. Air Cooled Variable Refrigerant Flow Systems

The Baseline for a proposed Air Cooled Variable Refrigerant Flow (VRF) system, in buildings located in an area where natural gas is available (as confirmed by ENS), shall be modeled with minimum efficiencies following ASHRAE 90.1 2013 Table 6.8.1-9 as summarized below. The part-load operation will follow the performance curves from NECB 2017 Table 8.4.4.21-E (Electric Air-Source Heat Pump Equipment Part-Load Performance). The Baseline heat pump operation must be set to a minimum operating temperature of -18°C.

System Description	Proposed System Details	Baseline System Type
System Type	Air-cooled VRF	Table 8.4.4.13-Packaged unitary rooftop heat pump
Central Plant	Air-cooled condensing units	Not Applicable
Fan Control	Multi-Speed	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Air cooled direct expansion	Air cooled direct expansion
Cooling Efficiency	Cutsheet	As per ASHRAE 90.1-2013-Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements (see Table 1)
Heating Type	Air source heat pump	Heat pump
Heating Efficiency	Cutsheet	As per ASHRAE 90.1-2013-Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements (see Table 1)
Auxiliary Heating Type	As per design	Electric Resistance with heat pumps operating under part load from -10°C to -18°C
Heat Rejection	Not Applicable	Not Applicable
Heat Rejection Efficiency	Not Applicable	Not Applicable
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

Table 1: Minimum Baseline VRF Heating and Cooling Efficiencies (as per ASHRAE 90.1 2013 Table 6.8.1-10)

The Size Category applies to the Baseline system, not the Proposed VRF.

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency
VRF Cooling Mode	<65,000 Btu/h	VRF multisplit system	13.0 SEER
	>=65,000 Btu/h and <135,000 Btu/h	VRF multisplit system	11 EER
	>=65,000 Btu/h and <135,000 Btu/h	VRF multisplit system with heat recovery	10.8 EER
	>=135,000 Btu/h and <240,000 Btu/h	VRF multisplit system	10.6 EER
	>=135,000 Btu/h and <240,000 Btu/h	VRF multisplit system with heat recovery	10.4 EER
	>=240,000 Btu/h	VRF multisplit system	9.5 EER
	>=240,000 Btu/h	VRF multisplit system with heat recovery	9.3 EER
VRF Heating Mode	<65,000 Btu/h (cooling capacity)	VRF multisplit system	7.7 HSPF
	>=65,000 Btu/h and <135,000 Btu/h (cooling capacity)	VRF multisplit system 47F db/43F wb outdoor air	3.3 COP
	>=65,000 Btu/h and <135,000 Btu/h (cooling capacity)	VRF multisplit system 17F db/15F wb outdoor air	2.25 COP
	>=135,000 Btu/h (cooling capacity)	VRF multisplit system 47F db/43F wb outdoor air	3.2 COP
	>=135,000 Btu/h (cooling capacity)	VRF multisplit system 17F db/15F wb outdoor air	2.05 COP

7.8. Ventilation Baseline for MURBs/hotels

Ventilation in MURBs or hotels is typically provided by either a central fresh air system or suite-level HRVs. NECB requires the baseline ventilation system configuration for MURBs to be identical to proposed. Baseline system details for each of these system types are outlined below.

7.8.1. Single-zone HRVs

System Description	Proposed System Details	Baseline System Details
Ventilation System Type	Single-zone (suite) HRVs Direct to zone or supplying fresh air to zone terminal systems	Zone supply fan and exhaust fan Configuration identical to proposed[1]
Heat Recovery	As per design	Not required
Fan Power	As per design (supply fan cutsheet, exhaust fan cutsheet)	Supply Fan: Identical to Proposed Exhaust Fan: Identical to Proposed
Fan Operation	Continuous	Continuous

Notes:

1. Configuration identical: if the proposed building uses suite HRVs that deliver fresh air directly to the zone through dedicated ductwork, the baseline building's ventilation system configuration will be identical. If the proposed building uses suite HRVs that are ducted to the zone terminal heating and cooling equipment, the baseline building's supply fan will be configured to serve the baseline heating and cooling equipment.

7.8.2. Central Ventilation Systems

System Description	Proposed System Details	Baseline System Details
Ventilation System Type	Central DOAS Direct to zone or supplying fresh air to zone terminal systems	Central DOAS Configuration identical to proposed[1]
Heat Recovery	As per design	NECB 2017 5.2.10.1.(3): minimum 50% SRE[2]
Fan Power	As per design (supply fan cutsheet, exhaust fan cutsheet)	Supply Fan: Identical to Proposed Exhaust Fan: Identical to Proposed
Fan Operation	Continuous	Continuous

Notes:

1. Configuration identical: if the proposed building's DOAS delivers fresh air directly to the zone through dedicated ductwork, the baseline building's ventilation system configuration will be identical. If the proposed building's DOAS is ducted to the zone terminal heating and cooling equipment, the baseline building's ventilation system will be configured to serve the baseline heating and cooling equipment.
2. For NECB 2015 projects, baseline heat recovery shall be modeled as per requirements outlined in NECB 5.2.10.

7.9. NECB Baseline HVAC system Descriptions

For buildings other than MURBs, and where the building is not heated using heat pump systems, the baseline HVAC system selection follows NECB Part 8 Table 8.4.4.7-A and Table 8.4.4.7-B. Descriptions for Systems 1 to 7 are provided below for clarity. In case of discrepancy with NECB, the energy modeler should follow the requirements in NECB Part 8.

System Description	Baseline System Type 1	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-1-Unitary air-conditioner with hot water baseboard heating	System-1-Unitary air-conditioner with electric resistance baseboard heating
Central Plant	Fuel Fired Water Boiler	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Fuel fired water boiler	Electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 2,7	
	Fuel-fired Heating in Proposed	Electric Heating in Proposed
System Type	System-2-Four-pipe fan-coil	System-2-Four-pipe fan-coil
Central Plant	Fuel Fired Boiler	Electric Resistance Water Boiler
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Water cooling water chiller	
Cooling Efficiency	SPVAC & SPVHP in Cooling mode	
Heating Type	Fuel Fired Boiler	Electric resistance water boiler
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Cooling Towers	
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 3	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-3-Single-zone packaged rooftop unit with baseboard heating	System-3-Single-zone packaged rooftop unit with baseboard heating
Central Plant	Fuel Fired Furnace	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Fuel Fired Furnace	Electric resistance furnace for rooftop, electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas-fired warm air furnaces	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 4	
	Fuel-fired Heating in Proposed	Electric Heating in Proposed
System Type	System-4-Single-zone make-up air unit with baseboard heating	System-4-Single-zone make-up air unit with baseboard heating
Central Plant	Fuel Fired Furnace	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-Air conditioner, all electric phases, Split and single-package	
Heating Type	Fuel Fired Furnace	Electric furnace with electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas-fired warm air furnaces Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 5
System Type	System-5-Two-pipe fan-coil
Central Plant	Water cooling water chiller
Fan Control	Constant-Volume
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Water cooling water chiller
Cooling Efficiency	Table 5.2.12-Packaged water chillers see Table 9 to 15 in standard
Heating Type	Not Applicable
Heating Efficiency	Not Applicable
Auxiliary Heating Type	Not Applicable
Heat Rejection	Cooling Towers
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20

System Description	Baseline System Type 6	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-6-Multi-zone built-up system with baseboard heating	System-6-Multi-zone built-up system with baseboard heating
Central Plant	Fuel fired boiler Water cooling water chiller	Not Applicable
Fan Control	Variable-volume	
Fan Power	8.4.4.18.(4)(b) Supply fan with 1000 Pa; Combined fan and motor efficiency 55% & Return fan with 250 Pa; Combined fan and motor efficiency 30%	
Cooling Type	Water cooling water chiller	
Cooling Efficiency	Table 5.2.12-Packaged water chillers see Table 9 to 15 in standard	
Heating Type	Fuel Fired Boiler	Electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Cooling Towers	
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

7.10. Baseline Requirements for Industrial Process Loads

The baseline requirements for new industrial buildings pursuing energy-efficient process equipment are as follows:

- Systems regulated by the NECB shall be modeled according to NECB Part 8, with the following exception:
    - Where facility processes require space temperature setpoints that differ from NECB-prescribed setpoints, both the baseline and proposed buildings shall be modeled with alternative setpoints as appropriate to the facility
- Unregulated process loads shall be modeled as follows:
    - Baseline equipment specifications and operating cycle times: Baseline process equipment specifications must be based on existing equipment/systems that are representative of industry-standard practices, as demonstrated by either
        - Equipment used in a similar facility/process, with the same owner as the proposed facility, where the equipment is less than 10 years old
        - Equipment used in three similar facilities/processes located in Canada or the United States
    - Proposed equipment specifications and operating cycle times shall be modeled based on a real system with available performance data
    - For all unregulated equipment, in both baseline and proposed buildings, specifications must be taken from data published by equipment manufacturers
    - The baseline and proposed models must include heating and cooling load effects of the equipment and operating cycles

8. eQuest Model Requirements

The following requirements and work-arounds apply to projects submitted in eQuest.

8.1. Effective Thermal Resistance

If the building is modeled in eQuest/CANQuest and has a heavyweight construction, the effective thermal resistance must be entered using the Layers method. The U Value keyword method is acceptable for assemblies that are considered lightweight construction (e.g. low heat capacity), though the layers method is recommended for improved accuracy.

8.2. Assemblies in contact with the ground in eQuest

If a project is modeled in eQuest/CANQuest, a modified method must be used for assemblies in contact with the ground. Heat transfer occurs mainly through the exposed perimeter rather than uniformly over the whole area of the surface. If the raw U-value of the surface is used, then heat transfer will be overestimated.

A simplified approach that is acceptable for the program is the method developed by Fred Winkelmann, which is outlined in the DOE-2 Modeling Tips document, "Underground surfaces: How to get a better underground surface heat transfer calculation in DOE-2.1E". A copy of this document can be provided by ENS upon request. Alternatively, modelers may use the eQuest Wizard for assemblies in contact with the ground, which is based on the Winkelmann method.

In this method, the effective U value is modified based on the exposed perimeter, using a sizing factor. Underground assemblies with no exposed perimeter are modeled with no heat loss. This applies only to projects modeled in eQuest or CANQuest; other software systems may use different calculation methods.

8.3. Water Loop Heat Pumps

Water loop heat pumps with ECM motors should be modeled as system type PVVT, which allow modulation of the air flow. PSZ system type can be used for constant-volume systems. Curve assignment is as follows:

- If the design includes standard WLHPs served by a boiler/cooling tower, the default HP curves can be used (HP-Heat-Cap-fEDB&EWT, HP-Heat-EIR-fEDB&EWT, HP-Cool-Cap-fEWB&EWT, and HP-Cool-EIR-fEWB&EWT). These curves are normalized for standard WLHP operating temperatures.

- If the design includes extended-range WLHPs connected to a ground loop, the default GSHP/WLHP curves should be used (GSHP/WLHP-Cool-Cap-fEwb&Ewt, GSHP/WLHP-Cool-EIR-fEwb&Ewt, GSHP/WLHP-Heat-Cap-fEwb&Ewt, and GSHP/WLHP-Heat-EIR-fEwb&Ewt) . These curves are normalized for extended range WLHPs.
- The modeler can also generate customized curves based on specified equipment, ensuring that the curves are normalized to the appropriate design operating temperatures of the loop

8.4. Dedicated Outside Air Systems: Dummy Zones

Projects that are modeled using eQuest or CANQuest must use the dummy zone method for 100% fresh air ventilation systems, for both the baseline and proposed models. The configuration must be identical in the baseline, i.e., if the proposed building has a ventilation system that is coupled to the zone heating and cooling equipment, the baseline ventilation system must also be coupled.

A system that provides 100% fresh air to the space, either through dedicated ductwork or directly to the terminal HVAC equipment, is modeled using a DOAS system that serves as a “dummy zone”.

The basic instructions for creating and assigning dummy zone systems are outlined below:

1. Create a “dummy space” with area (square feet) equal to 1/3**supply flow rate* (cfm), where *supply flow rate* is the total code-minimum outside air requirements for the spaces served.
    - Code-minimum outside air should be determined outside of the model, and must be based on ASHRAE 62.
2. Create a new corresponding thermal zone called “dummy zone”
3. Set the heating and cooling schedules and temperature setpoints as follows:
    - For decoupled ventilation systems, identical to zone schedules and setpoints.
    - For coupled ventilation systems, use design setpoints and applicable NECB schedules

4. Create a new HVAC system (PSZ for constant volume systems, PVVT for variable volume).
5. Set the control zone to "dummy zone"
6. Set the heating and cooling equipment as per instructions in 8.4.1 and 8.4 below
7. Set the fan power "supply and return" equal to proposed system fan power
8. Set the minimum outside air ratio to 1.0 and fan mode to continuous
9. Set the supply flow rate equal to *supply flow rate* described above
10. Repeat steps above as needed, based on proposed ventilation system design
11. To avoid model errors, the dummy zone DOAS unit(s) must be moved to the top of the HVAC systems in the model's INP file.
    - Save and close the eQuest file
    - Open the .INP file
    - Find the dummy zone DOAS unit(s) in the section "HVAC Systems/Zones"
    - Select the text corresponding to the DOAS unit(s) and associated zone(s). Start at the first line, e.g. "DZ DOAS" = SYSTEM, and end after SPACE = "dummy zone". Be sure to include the ". ." line.
    - Cut this text selection, and paste at the top of the HVAC systems list.
    - Save and close the .INP file.
    - Reopen the eQuest file and ensure that the DOAS units are at the top of the air-side systems list
12. Set the zone outside air as follows:
    - If the proposed building has a decoupled ventilation system, set the secondary system outside air ratio to 0 (zone fans intermittent)
    - If the proposed building has a coupled ventilation system, set the secondary system "OA from system" to the applicable dummy zone DOAS (zone fans continuous)

Detailed instructions for modeling DOAS in MURBs are provided below. For all other building types, the model must be configured such that the outside air is conditioned as per design intent (for both temperature and humidity control). See section 8.5 for additional DOAS modeling requirements.

8.4.1. Central DOAS in Proposed, Decoupled from Zone Equipment

If the proposed building has one or more multi-zone fresh air systems, the modeled ventilation system must match its configuration; i.e. each separate system in the design must have a separate dummy zone and associated DOAS, where each is modeled with fan power and H/ERV efficiency modeled as per design specifications. The air flow assigned to each dummy zone system must match the sum of zone air flows for the spaces it serves.

If the proposed DOAS is decoupled from the zone equipment, and zone equipment runs intermittently, the DOAS supply temperature must be preconditioned to the zone supply temperature.

Two options exist for modeling a decoupled, central DOAS:

1. Fresh air conditioned by zone equipment (DOAS is a central H/ERV)

This option is most appropriate for proposed systems with minimal heating and cooling equipment, where the equipment operates only part of the year and the energy consumption of the heating and cooling equipment is minimal in comparison to the zone equipment energy consumption. For example: A central DOAS with heat wheel and electric coil, and minimum supply air setpoint of 18°C.

In this method, the DOAS is modeled the same as single-zone HRVs, i.e.:

1. Heating and cooling equipment type and efficiency is identical to the zone equipment, for both baseline and proposed building.
2. DOAS supply temperature setpoint is set to the zone temperature setpoint
3. Each secondary system must be modeled with “OA from system” set to “undefined”, and secondary system minimum outside air ratio set to 0.

2. Fresh air conditioned by DOAS equipment

This option is most appropriate for proposed systems with heating and cooling equipment that meet a larger portion of the fresh air heating/cooling loads, where the equipment operates most of the year and the energy consumption of the heating and cooling equipment is more significant in comparison to the scenario outlined in option 1 above.

In this method, the DOAS is modeled as follows:

1. Heating and cooling equipment type and efficiency as per design specifications and associated baseline requirement
2. DOAS supply temperature setpoint is set to the zone temperature setpoint
3. Each secondary system must be modeled with "OA from system" set to "undefined", and secondary system minimum outside air ratio set to 0.

   If the DOAS supply temperature is less than the zone setpoint, and the DOAS includes a heat recovery device, an adjustment must be added to the exhaust air. See section 8.4.4.

8.4.2. Central DOAS in Proposed Building, Coupled to Zone Equipment

If the proposed DOAS provides outside air via terminal equipment, the dummy zone DOAS must be modeled as follows:

1. *DOAS without heating/cooling equipment*

If the DOAS provides fresh air and exhaust only, the dummy zone system is configured as follows:

- Dummy zone outside air equal to total supply OA rate for all zones served
- Dummy zone setpoints equal to zone setpoints
- Dummy DOAS equipped with heating and cooling equipment identical to terminal devices
- Zone outside air rates set per each zone requirement
- Terminal equipment "outside air from system" set to dummy DOAS

2. *DOAS with heating/cooling equipment*

If the DOAS provides conditioned air at a given supply setpoint, the dummy zone system is configured as follows:

- Dummy zone outside air equal to total supply OA rate for all zones served
- Dummy zone setpoint schedule equal to design supply air setpoints
- Dummy DOAS equipped with heating and cooling equipment per proposed DOAS
- Zone outside air rates set per each zone requirement
- Terminal equipment "outside air from system" set to dummy DOAS
- If the DOAS is equipped with heat recovery, exhaust pre-heat must be added to dummy DOAS per section 8.4.4 below.

8.4.3. Single-zone HRVs in Proposed Building (MURBs)

If the proposed building's fresh air system is comprised of suite-level HRVs, the modeled ventilation system can be a single dummy zone DOAS. The supply flow must still be the sum of all zone outdoor air flows. In this case, the DOAS is modeled with heating and cooling equipment identical to the zone heating and cooling equipment (for both baseline and proposed), and proposed heat recovery specifications identical to the suite HRVs; this ensures that air supplied by the DOAS is conditioned exactly as it would be if it entered the space via HRVs. Fan power must match the W/cfm of the proposed building's HRVs.

Each zone system must be modeled with "OA from system" set to "undefined", and zone OA set to 0. Zone system fan operation is set as per requirements in section 7.7 (identical to proposed).

8.4.4. DOAS Heat Recovery

Additional guidelines for DOAS equipped with heat recovery are outlined below.

1. *Fan Power in Heat Recovery Applications*

To accurately model heat recovery fan operation, the fans must be modeled as follows (for both baseline and proposed heat recovery applications):

1. Set the main DOAS supply and exhaust fans to the NECB/ENS requirement (baseline model) and design fan power (proposed model)
2. In the "outdoor air – heat recovery 2" tab, set ERV Fans to "HVAC Supply/Return"
3. In the same tab, set "Delta P @ Dsgn Flow" as 0 for both Make-up and Exhaust
4. In the "outdoor air – heat recovery 2" tab, set the ERV operation to "When Fans On", where the main DOAS fans have been set to run on the applicable fan schedule.

2. *Heat Recovery in Coupled Ventilation Systems*

In buildings where the DOAS supplies fresh air via terminal equipment, and is equipped with heat recovery on the exhaust stream, an adjustment must be implemented to ensure the exhaust air temperature is set to zone temperatures. By default, eQuest will model the exhaust air temperature as equal to the dummy zone temperature, which is set by the DOAS supply air setpoint (typically lower than zone temperature).

The adjustment is modeled as follows (for DOAS with no heating and cooling equipment):

1. In the "Heat Recovery 2" tab, set Condensation/Frost Ctrl to "Preheat Exhaust"
2. Set the Preheat Temp Ctrl to "Fixed Setpoint" and enter the zone temperature setpoint
3. Set the Preheat Source to "Electric"
4. In the "Meters" tab, set the system's "Space Heating" to a dummy meter

If the DOAS is equipped with heating (gas or electric), the exhaust preheat must be set to hot water, served by a dummy boiler (such that preheat energy is not added to the system's heating energy consumption). In this case, the adjustment must be modeled as follows:

1. Create a dummy fuel-fired boiler and associated pump
2. Set boiler and pump energy consumption to dummy meters (one fuel and one electric)
3. In the DOAS "Heat Recovery 2" tab, set Condensation/Frost Ctrl to "Preheat Exhaust"
4. Set the Preheat Temp Ctrl to "Fixed Setpoint" and enter the zone temperature setpoint
5. Set the Preheat Source to "Hot Water" with the associated dummy boiler
6. Keep the DOAS space heating on the main meter (electric or gas)

8.5. Additional Modeling Requirements for DOAS

Model parameters for DOAS units and associated dummy zones must be carefully selected to ensure the modeled system reflects design conditions. Models must consider the following:

- Humidity setpoints for zones and supply air
- Frost protection on heat wheels, when the exhaust preheat adjustment has been used
- Dummy zone schedule for variable flow DOAS

Because the inherent variability in HVAC system design across different building types, DOAS modeling requirements will be reviewed and assessed on a case by case basis.

8.6. Modeling of Water to Water and Air to Water Heat Pumps for Service Hot Water Applications

In eQuest/CANQuest models, service hot water equipment is limited to three types of water heaters:

1. Gas-fired water heater,
2. Electric resistance water heater,
3. Heat pump water heater with electric resistance backup.

The heat pump water heater module includes a set of 3 curves that provide the capacity and efficiency as a function of the environment temperature and part load ratio. It is imperative that the location of the heat pump is set correctly (indoor in a conditioned zone or outdoor) as the program will use the zone temperature when calculating the heat pump water heater performance.

The capacity and EIR (Energy Input Ratio) curves can be modified based on manufacturers engineering manuals. Default curves can be used when data is not available.

The systems also include a backup/supplemental immersion electric heater and requires the following inputs:

1. The capacity of the immersion heater. The default is the capacity of the heat pump.
2. Maximum heat pump supply temperature. This is the maximum water temperature that the heat pump can provide. Any additional boost to the supply temperature will be provided by the backup immersion heaters.

Proposed water-source heat pump water heaters must be modeled with the location set to an indoor heated zone and with the Capacity, EIR and PL-EIR set according to manufacturer's data. If the source is other than ground loop, the source energy consumption must be calculated outside of the model and added to the simulation output. Other methods may be used but are subject to ENS approval.